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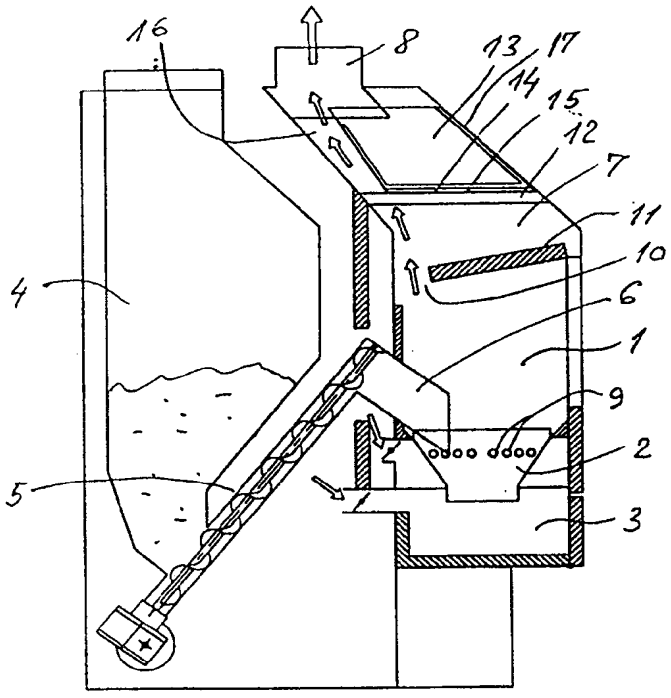
(54) **Title:** SELF–STOKING WOOD PELLET STOVE

(57) **Abstract**

The invention concerns a self–stoking stove fuelled by wood pellets or similar types of solid fuel in pelleted or granulated form. The innovative feature of the invention consists in the inclusion in the smokebox of the stove of a system of guide plates that guides the flue gases in such a way that the smoke is made to pass through a convection mantle disposed on the front and sides of the stove, in order to give off the maximum quantity of heat to the surroundings before being conducted away through the chimney. The guide plates are displaceable between two extreme positions, where one extreme position corresponds to the normal operating position with the smoke being directed through the convection mantle, and the other extreme position is a "bypass" position, in which the smoke flows directly from the combustion chamber to the chimney by–passing the convection mantle.



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SELF-STOKING WOOD PELLET STOVE

Field of application of the invention

The invention concerns a self-stoking stove fuelled by wood pellets or similar types of solid fuel in pelleted or granulated form. The self-stoking stove is principally intended for the heating of private houses, flats, holiday homes and other locations where there is a need for an economical and environment-friendly form of space heating. The self-stoking stove is principally conceived as an alternative to conventional stoves of the type intended for manual stoking with firewood, but in certain cases can indeed replace central heating installations and electrical heating systems.

Prior Art

US Patent No. 5,285,738 discloses a pellet-fuelled stove with a combustion chamber and a separate pellet hopper from which a worm conveyor driven by a geared electric motor transports the pellets to a discharge chute, whence they slide out onto a fire-supporting means. The combustion air is comprised of a primary air current to the fire-supporting means and a secondary air current to a front window.

The combustion air is blown into the firebox by means of two electrically driven blowers, which are incorporated into the stove itself. Heat output is regulated by stepwise adjustment of the speed of revolution of the worm conveyor, and the combustion air is automatically adjusted according to the rate of delivery of pellets by controlling the blower output, i.e. adjusting the rpm of the blowers. An electric or electronic control unit controls the different motor speeds relative to each other for optimum combustion efficiency under the various conditions of load at which the stove can operate. The flue gases produced by the combustion process are extracted through a chimney in the usual manner, making use of the natural draught of the chimney.

The technical problem to be solved

The use of electrically driven blowers to generate the flows of combustion air in the stove (primary and secondary combustion air) is undesirable for several reasons. Firstly, blowers make the stove unnecessarily complicated and costly; and secondly, they cause a (small) positive pressure in the firebox. This pressure can in adverse circumstances - caused by a blocked flue or chimney, for example - lead to a risk of explosion or carbon monoxide poisoning. It is preferable in all circumstances to use only the chimney draught to produce the primary and secondary combustion air currents. This principle of combustion yields the simplest stove design and at the same time means that there is a negative pressure in the firebox during operation, i.e. the risk of explosive gases building up in the stove or poisonous flue gases escaping into the room is eliminated. Moreover, costly electrical energy to drive the blowers is saved.

If the currents of primary and secondary combustion air through the stove are to be generated solely by chimney draught, there is a problem with starting the stove from cold, i.e. with a cold chimney. In this situation, where the chimney draught is less than in the normal "hot" state, smoke will escape into the room. Naturally, that is not acceptable. The object of the present invention is precisely to provide a fanless pellet-fuelled stove as discussed in which this problem has been solved.

The technical innovation

The innovative feature of the invention consists in the inclusion in the smoke outlet path between the combustion chamber and the chimney of the stove (the smokebox) of a system of guide plates that guides the flue gases in such a way that the effective length of the smoke path is increased and the smoke is made to pass through a convection mantle disposed on the front and sides of the stove, in order to give off the maximum quantity of heat to the surroundings before being conducted away through the chimney, said guide plates, or a smoke path selecting plate associated with the guide plates, being adjustable by linear or angular displacement between two extreme positions, where one of said extreme positions corresponds to the normal operating position with the smoke being directed through the convection mantle as described, and the other of said extreme positions is a "by-pass" position, in which the guide plates or smoke path selecting plate open(s) a hole or passage in the smokebox thereby connecting the combustion chamber directly with the chimney, so that in this position the smoke can flow directly from the combustion chamber to the chimney, i.e. by-passing the convection mantle.

The technical effect

By applying the innovation described above to the prior Art, it is possible to cause the flue gases to by-pass the convection mantle while getting the stove started, i.e. for as long as the chimney and stove are still cold and the draught is accordingly too weak to prevent smoke escape. The flue gases can thus flow directly from the combustion chamber up/out into the chimney with resistance to flow reduced to a minimum. In this way, escape of smoke into the room is avoided. The smoke guide plates are switched automatically between their lighting-up position (the by-pass position) and their position for normal operation by means of an electric guide vane motor or similar motorised drive device. The position is determined by the central stove controller. Alternatively, the stove can be equipped for manual switching, in which case the guide plates are furnished with an external control lever.

The problems associated with lighting-up a fanless solid fuel stove of the type here discussed are completely solved by the smokebox control according to the invention. The pellet-fuelled stove according to the invention is further marked by the absence of technical complexity, whilst it also combines the best characteristics of a traditional stove (negative pressure stove) with the advantages offered by a modern self-stoking stove in terms of fully automatic operation, efficient combustion and wide output adjustment range.

The invention and especially advantageous embodiments and particulars thereof will now be described in detail, with reference to the accompanying drawings.

List of drawings

Fig. 1 shows a vertical section through a pellet-fuelled stove according to the invention, with the smokebox control set to by-pass.

Fig. 2 shows the same section with the smokebox control set to normal operation, i.e. where the flue gases are directed through the front-and side-facing convection mantle of the stove.

Fig. 3 is an enlarged cross-section showing the various air intake paths in the stove with their associated regulator valves in schematic section.

Examples of embodiments

In the embodiment shown in the drawing, the self-stoking stove in essence comprises a combustion chamber (1), a pot-shaped fire vessel (2), an ashbox (3), a pellet hopper (4) with a worm conveyor (5), a pellet chute (6) and a smokebox (7) with a flue pipe (8), which is connected to a chimney (not shown). The bottom of the fire vessel (2) is a grate intended for the supply of primary combustion air from below, and its sides are provided with a number of holes (9) for the supply of secondary combustion air. Fuel pellets are delivered from the chute (6) directly into the fire vessel, where combustion takes place. The ash falls through the grate at the bottom of the fire vessel and is collected in an ashpan (not shown) in the ashbox (3).

The flue gases produced by combustion rise from the combustion chamber (1) up into smokebox (7) via a passage (10) at the back of the firebox. The partition between the combustion chamber and the smokebox consists of a sloping, heat-resistant baffle (11). At a distance above said baffle in each side of the smokebox (7) is disposed a set of horizontal guide rails (12) which provide the support for a truncated-cone-shaped body (13), the function of which is to direct the smoke within the smokebox itself. The conical body (13) is mounted on a horizontal plate (14), which in turn rests on a frame comprising two parallel lateral profile pieces (15), which are supported on the said two guide rails (12) so as to allow the conical body to be displaced between a front position (Fig. 1) and a back position (Fig. 2). The conical body (13) is open-topped and this aperture partially surrounds the flue pipe (8), which is extended a short distance down into the smokebox itself.

When the stove is being lit, the conical body (13) is in the front position. In this position the conical body itself together with its baseplate (14) offers a free vertical passage (16) at the back of the smokebox, which passage creates a direct route between the combustion chamber (1) and the flue pipe (8), so that in this position the smoke can rise unobstructed up the chimney. When the stove and chimney have heated up, and the draught therefore corresponds to normal operating conditions, the conical body (13) is displaced to the rear, thereby blocking the passage (16), and the flue gases are then caused by the conical body to flow up along the inside of the front and sides (17) of the smokebox (7). At the top of the conical body (13) the smoke is forced downwards into the conical body itself, and thence up again into the flue pipe (8). The directions of the smoke flow are indicated by arrows in Fig. 2. The front and sides of the stove then function as a convection mantle which contributes to cooling the flue gases and thereby to the good heat output and optimum thermal efficiency of the stove. The mechanism controlling the conical body (13) is not shown in the drawing.

Fig. 3 schematically depicts the air intake system of the stove. Combustion air enters at the front of the stove through two hollow profiles (20) located at each side of the smokebox (7) immediately below the horizontal guide rails (12). On

each side of the stove is located another horizontal duct (21), which conducts a small portion of the combustion air to a number of air entry apertures (22) placed at the inside of the front window (23) of the firebox. The combustion air supply to the front window is controlled by a preset regulator valve (24) in the duct (21).

The rest of the combustion air is divided into a primary and a secondary combustion air current. The primary combustion air is conducted to the grate at the bottom of the fire vessel via a regulator valve (25) and the ashbox (3). The secondary combustion air is led to the side holes (9) of the fire vessel via another regulator valve (26) and an intermediate space (27) in which the air is distributed and which surrounds the side surfaces of the fire vessel. Before being led to the combustion zone in the fire vessel, the combustion air is preheated during its passage through the air inlet ducts (20) and over various heat convection surfaces (28) on the back of the firebox. It should be mentioned that apart from the flue pipe connection (8) the stove is of a completely sealed design, so that maximum use can be made of the chimney draught to generate in the stove the flows of combustion air described above.

Control of the heat output of the stove (power regulation) is effected primarily by adjustment of the rate of supply of fuel pellets to the fire vessel, i.e. by control of the worm conveyor (5). The combustion air is regulated according to the quantity of fuel supplied by means of automatic adjustment of the two regulator valves (25) and (26), which regulate primary and secondary combustion air respectively. A geared motor (not shown) operates both valves. Control of the quantity of fuel delivered and of the regulator valves is effected from a central electronic controller, for example of the PLC type. The controller may be subordinated to a thermostatic controller connected in the usual manner.

The invention is not limited to the embodiment shown in the drawing and described above. Other combinations of materials, other detailed embodiments and other constructive solutions for individual parts of the stove and the associated control system can be envisaged within the scope of the present invention, and it can also be envisaged that the applications of the stove could be extended to other areas than those named.

CLAIMS

1. A self-stoking stove with a combustion chamber and a separate pellet hopper from which a worm conveyor driven by a geared electric motor transports the pellets to a discharge chute, whence they slide out onto a fire-supporting means, and wherein the combustion air is divided into a primary air current which is conducted to the bottom of the fire-supporting means and a secondary air current which is led in through the side of the fire-supporting means through a number of holes therein, which combustion air is preheated during passage through a convection mantle in the stove and by contact with the outer surface of the combustion chamber before being admitted via automatically controlled regulator valves to the fire-supporting means itself, characterised by the inclusion in the smoke outlet path between the combustion chamber and the chimney (the smokebox) of a system of guide plates that guides the flue gases in such a way that the effective length of the smoke path is increased and the smoke is made to pass through a convection mantle disposed on the front and sides of the stove, in order to give off the maximum quantity of heat to the surroundings before being conducted away through the chimney, said guide plates, or a smoke path selecting plate associated with the guide plates, being adjustable by linear or angular displacement between two extreme positions, where one of said extreme positions corresponds to the normal operating position with the smoke being directed through the convection mantle as described, and the other of said extreme positions is a "by-pass" position, in which the guide plates or smoke path selecting plate open(s) a hole or passage in the smokebox thereby connecting the combustion chamber practically directly with the chimney, so that the smoke can flow directly to the chimney, by-passing the said convection mantle.

2. A self-stoking stove according to claim 1, characterised in that the smoke guide plates or smoke path selecting plate are/is switched between their/its

two extreme positions by means of an electric motor, which is controlled by the central controller of the stove.

3. A self-stoking stove according to claim 2, characterised in that switching between the two positions (by-pass and normal) is effected automatically in dependence on various operating parameters, for example chimney temperature, stove temperature, time elapsed since lighting-up, etc.

4. A self-stoking stove according to claim 1, characterised in that the said guide plates in the smokebox are comprised of a substantially closed, conical body, mounted on a set of parallel, horizontal profile pieces, which rest on a set of corresponding rail profiles built in at the bottom of the smokebox, so that the conical body can be displaced on said rails between a front position (Fig. 1), where a practically vertical passage is created through the smokebox between the rear wall of the smokebox and the rear surface of the conical body, which passage connects the combustion chamber and the chimney directly (by-pass), and a back position (Fig. 2), where the rear of the conical body blocks the said vertical passage and instead the front and two side surfaces of the conical body direct the smoke up along the inside of the front and sides of the smokebox (= convection mantle).

5. A self-stoking stove according to claim 4, characterised in that the said conical body is truncated and is open at the top with the upper portion of the rear of the conical body having been removed so that space is created for the stove flue pipe, which projects a short distance down into the open top of the cone, whereby the smoke is made to pass up and over the upper edge of the truncated cone and a short distance downwards into it before being able to escape via the flue pipe (assuming that the conical body is in the position for normal operation, Fig. 2).

6. A self-stoking stove according to claim 1, characterised in that both the primary and the secondary combustion air are regulated by means of separate regulator valves, which are adjusted automatically by means of dedicated electric motors and controlled by the central controller of the stove.

7. A self-stoking stove according to claims 1 and 6, characterised in that a small portion of the air taken in by the stove is conducted to a number of slit-shaped air entry apertures inside the firebox behind the front window, so that the front window is kept clear, and so that the quantity of air to the front window in relation to the total air intake is determined by an adjustable air separator valve (regulator valve) which under normal conditions is preset.

8. A self-stoking stove according to claim 1, characterised in that the fire-supporting means is pot-shaped and simply rests in an opening provided for it in the bottom of the firebox.

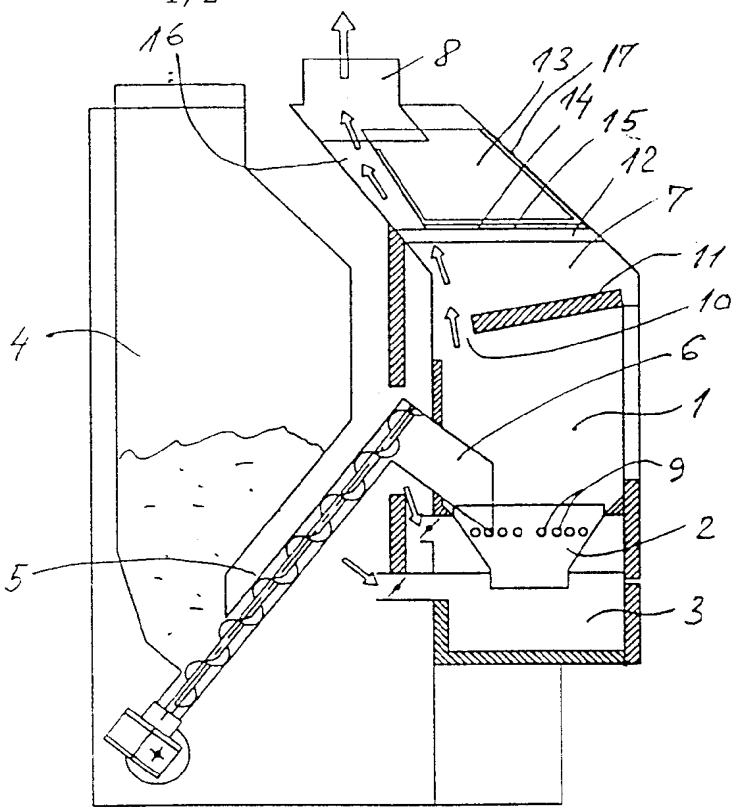

Fig. 1

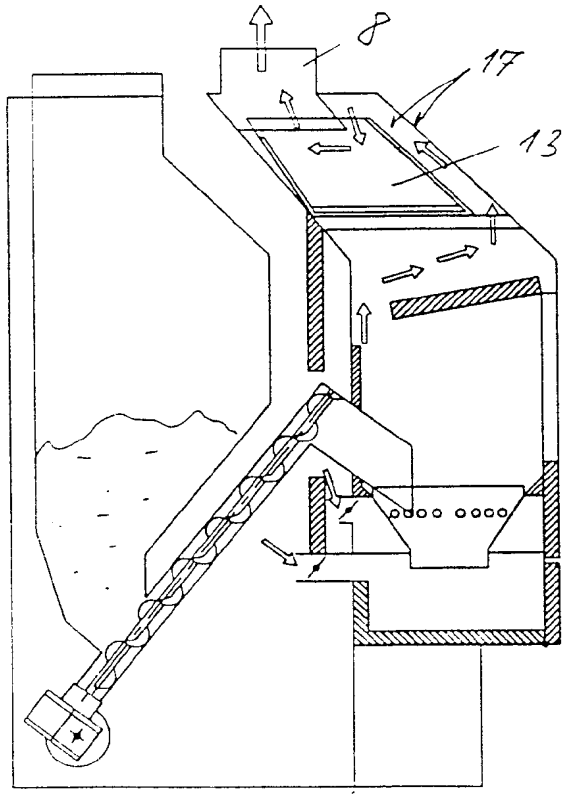

Fig. 2

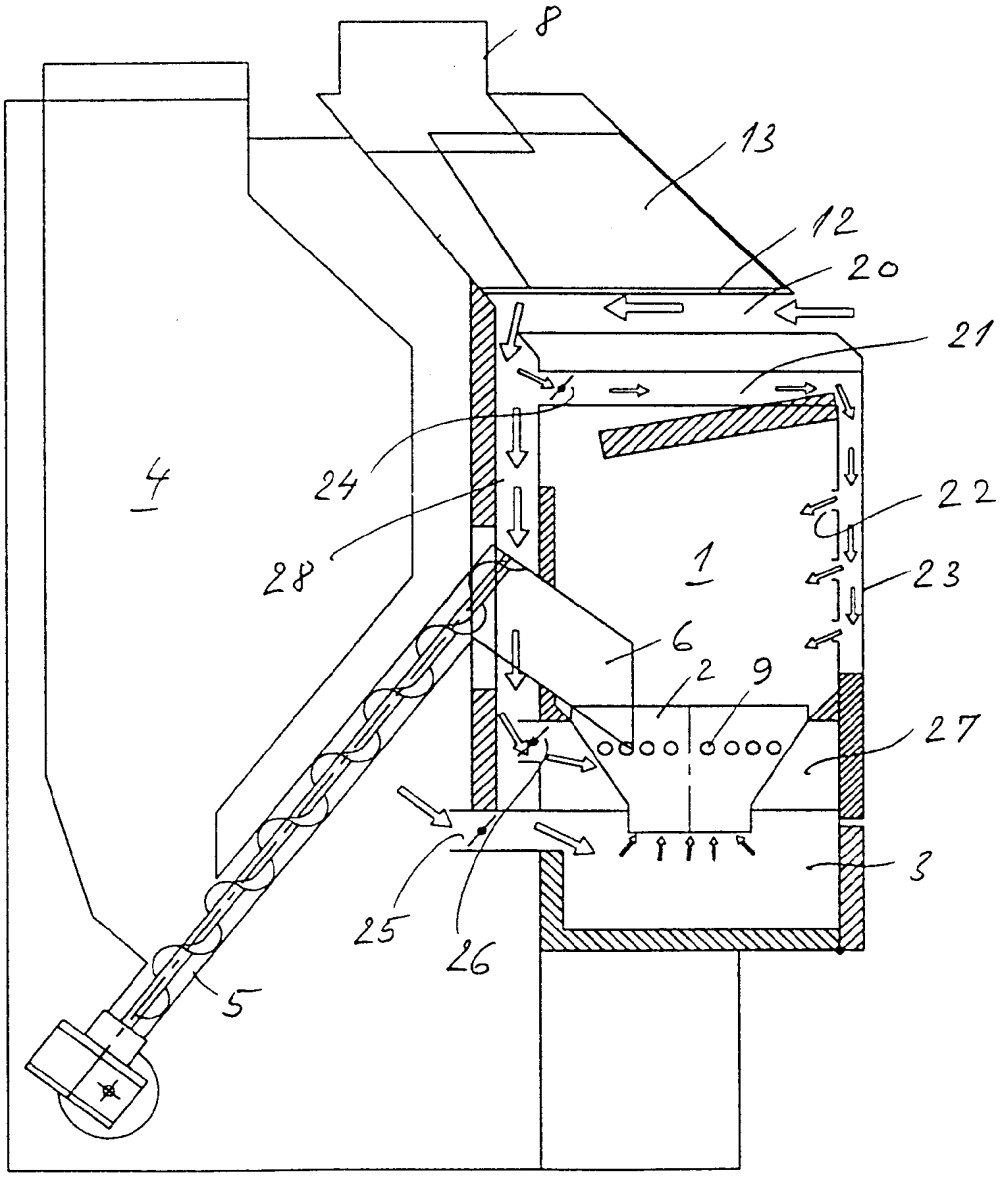

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 98/00409

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24B 1/189, F24B 5/02 // F24B 1/185, 7/00, F23N 3/00, F23M 9/00, F23C 11/00
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0708298 A2 (POSCH, HERIBERT), 24 April 1996 (24.04.96), column 11, line 42 - column 12, line 33, figures 1-5	1
X	SE 452054 B (STELLAN FORSBERG), 9 November 1987 (09.11.87), page 2, line 5 - line 18, figures 1-3	1
X	DE 19631701 A1 (FREI, MARTIN), 13 February 1997 (13.02.97), figure 2, abstract	1
A	SE 450735 B (STELLAN FORSBERG), 20 July 1987 (20.07.87), figure 1, abstract	1-8

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5285738 A (CULLEN), 15 February 1994 (15.02.94), figure 1, abstract -- --------	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/12/98

International application No.
PCT/DK 98/00409

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DE 19631701 A1	13/02/97	NONE	
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US 5285738 A	15/02/94	US 5133266 A	28/07/92